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UNDERSTANDING THE READING PROCESS.

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PROJECT LITERACY IS A GROUP OF COOPERATING RESEARCHERS WHO PLAN THEIR RESEARCH TOGETHER AND MAKE THEIR FINDINGS RAPIDLY AVAILABLE FOR SMALL-SCALE TRYOUTS. IN THIS WAY, ADVANCES BOTH IN BASIC EDUCATIONAL RESEARCH AND EDUCATIONAL PRACTICE CAN BE PROMOTED. THE FOLLOWING ASSUMPTIONS HAVE GUIDED A GROUP OF RESEARCHERS AT CORNELL--READING INVOLVES SAMPLING THE WRITTEN TEXT AND SAMPLING IMPLIES THE ACTIVE PROCESSING OF SOME INFORMATION. SAMPLING DEPENDS ON SUCH CHARACTERISTICS AS SPACING, TYPE ALIGNMENT, ON THE DIFFICULTY OF THE MATERIAL, ON GRAMMATICAL STRUCTURE, ON THE INTENTION OF THE READER, AND REFLECTS THE SKILL OF THE READER. STUDIES OF SPACING BETWEEN WORDS, THE EFFECTS OF GRAMMATICAL STRUCTURE ON READING, AND EYE-VOICE SPAN IN READING ACTIVE AND PASSIVE SENTENCES ARE DISCUSSED. IT WAS CONCLUDED THAT THE CHILD SHOULD BE EXPOSED TO MIXED STRATEGIES EARLY IN THE BEGINNING READING STAGE. FAMILIARITY WITH VARIOUS CUES IN COMPLEX COMBINATION, INCLUDING PHONIC, GRAMMATICAL, AND MEANING ASPECTS OF THE MATERIALS, LEADS TO MATURE READING BEHAVIOR. THIS PAPER WAS PRESENTED AT THE 31ST EDUCATIONAL CONFERENCE SPONSORED BY THE EDUCATIONAL RECORDS BUREAU, NEW YORK, OCTOBER 28, 1966. (JM)

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Understanding the Reading Process[1/]

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I should first like to register a major caveat. I do not know the best method by which to teach children to read. I don't think there is a best way. I think there are many ways, depending on the purposes for which you want the child to read and the kinds of children you are concerned with. For our purposes, a more fruitful question is: What are the processes of reading? How do we understand this extremely complex visuo-motor-linguistic-psychological skill? I am pleased that many psychologists and linguists are becoming concerned with reading, because I have the faith of the experimentalist that answers will come from experimentation coupled with interrelated practical research and development.

I want to emphasize the ties between research and practice since I started work on this topic with some naive assumptions. I believed that all one had to do to understand the best way to teach children to read was to work busily in the laboratory for five years or so, to let the facts accumulate and with the process understood, the way to acquire the process would be obvious. It took less than a year to discard that simple-minded notion. We were not asking the right kinds of questions, and we could not ask the right kinds of questions until we saw what was happening in the classroom. At the same time, I do not think we can do an optimal job in the classroom without recourse to the laboratory.

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1/ Speech delivered to the 31st Educational Conference sponsored by Educational Records Bureau in New York City. October 28, 1966.

It happens to be one of my firmest faiths that we will make great advances both in basic educational research and educational practice if we have a formal tie between basic research and its practical applications. This has happened in other fields. The relationship between physics and engineering is clear; between biochemistry and medicine is reasonably clear. These relationships can be generated by appropriate ecologies. I have a vision of learning, perception and language behavior laboratories operating in close proximity to classrooms so that they can feed each other day by day. This is one way that the lag between research and practice might be reduced. In this way, also, important and interesting questions will come from the educational situation into the laboratories. The consequences could be overwhelming. If you are trained to look for researchable problems, one day in the classroom yields perhaps a lifetime of research.

At any rate, Project Literacy, about whose work I will talk, is a group of cooperating researchers who plan their research together, who communicate with each other and whose findings are rapidly available for small scale try-outs. Also, the problems which become clear during the try-outs are fed back to the laboratories for additional attention. We have been supported by funds from the U.S. Office of Education.

Let me tell you about a set of working assumptions that have guided some of the research of a group working with me at Cornell. I hesitate to call them hypotheses, but they provide a model that has been useful to us. I will describe three studies. Then I will draw a few conclusions about what the results may mean for practice.

I will go through the list of working assumptions about the mature, skilled reading process.

The first is a simple-minded heuristic. Reading is basically a process of sampling the written text. A linguist with whom I worked made the point that a good reader is a good cheater. Sampling implies that there is, in reading, an active processing of some information, and the inference of other information from what you have actually taken in, or what you have sampled. This is not unlike any sampling procedrue, for example, in public opinion studies, where information is gathered from a small group of people and inferences drawn about what everybody else believes. Sampling, I think, implies that you attend to less than the total available information.

Let me cite an example. I am sure each of you has read a passage which at the end did not make sense. Usually, it doesn't make sense in a categorical way, because you have not read little words like "not," and "um." You can usually skip back to the word that you missed and now the passage is sensible. This suggests that you have missampled a critical part of the text. The part does not adequately reflect the whole.

The second working assumption is that reading is a process of hypothesis-making and confirmation. Reading is similar to talking, in this respect. When we talk, you make guesses about what I am going to say next so you don't listen to every word. But you do sample my speech and you trust your sampling strategy as long as the discourse fits your expectations. As the fit lessens, you begin to sample more densely. You listen more closely, in the same way that you begin to read every word.

One other point that the sampling notion implies is that with predictable content sampling points can be wider. On what bases does the density of sampling occur? How do we predict the sampling strategy? Perhaps of concern to many of you is, How do we train for efficient strategies?

If we read less than the total text, what determines the sampling points? A working assumption, guiding our research is that the density of the sampling depends on what I shall call the physicomic characteristics of the text, which includes spacing, typeface, lines, and so forth. Typeface if usually an unobstrusive aspect of reading. I think of printer's type as akin to dialects in spoken language. We may be aware of them but we understand a wide variety of them. Spacings between words are obvious characteristics of print, yet I will shortly tell you about a study that demonstrated the utility of spaces for sampling the text.

Another interesting problem is, How does the reader go from line to line so accurately? It seems easy. And we do it very efficiently. But how? The first guess is that it has something to do with the beginning of the next line. We made up a text in which every line began with the same word. The children and adults tested had no trouble in finding the next line. Then we used texts where each line began with the same group of words. Again, readers had no trouble in finding their way. Finally, we carried out an interesting informal experiment. The text was put on a board which moved eccentrically. The page, though, moved as a whole, preserving the relationships between the lines. This odd arrangement, too, does not change our ability to find the correct line. The best guess,

and the only one that fits all of the information I have cited, is that we build a visual lattice between the lines. We know the line we are on: we know the line we are going to. So, the eyes weave a lattice between the two lines until they reach the beginning of the next line.

More working assumptions. The sampling depends on the difficulty of the materials. We can, I think, force word by word reading, that is, a very find grained sampling procedure if the reading is difficult. This primitivization to word-by-word reading can be tested. Not only does difficulty hobble the readers' eyes but it also makes overt the oral component of reading usually lost by skilled readers. We plan in our laboratory to measure, through amplification techniques, the increase in the electropotential of the laryngeal muscles and the lips, as our subjects are given more and more difficult materials to read. In other words, when confronted with difficult materials, the reader is forced into a more fine grained sampling of the text and he also seems to go back to more primitive type of reading, of the sort that occurred when he first learned to read.

Another assumption is that that sampling depends on the grammatical structure of the material. My own research is on this topic and I shall take it up in some detail in a moment.

The nature of the sampling depends on the intentions of the reader. To make this assumption obvious, consider the way we read if we are simply skimming the text and contrast skimming with reading to commit the materials to memory. These distinctions are now part of educational practice.

The final working assumption is that at any level, the units which are sampled depend on the skill of the reader. You may observe this truism when listening to oral reading. Unadaptive sampling is relected in word-by-word, stacotto reading, whereas wider sampling is shown by reading in normal intonation patterns.

Thus far I have made the following points:

1. Reading involves sampling the written text.
2. Sampling implies the active processing of some information and inferring other information.
3. The nature of sampling depends on such characteristics as spacing, type, and alignment.
4. Sampling depends on the difficulty of the material.
5. Sampling depends on grammatical structure.
6. Sampling depends on the intention of the reader.
7. Sampling reflects the skill of the reader.

To insist that reading is sampling, implies a plan for receiving information from the page. The plan carries the reader from one point to another in the text and determines what he actually sees and what he infers. To say that reading is planned does not necessarily imply that the plan is conscious. In most cases, it is a highly automatic set of habits. One determinant of the plan is the physiognomic characteristics of the printed page.

What would happen if we didn't have white spaces between words? There are some alphabets that exist without white spaces. If the eye is moved ahead to pick up information or even positioned to be moved ahead,

it is likely that the white spaces provide information about where to look next. If we make the reasonable assumption that such planned behavior increaes with skill in reading, the following hypothesis is generated: The elimination of white spaces will influence skilled readers more than beginning readers.

This experiment was carried out by Hochberg, Levin and Frail. We prepared a series of paragraphs matched in difficulty for children in the first, second, fifth and sixth grades. For some of the texts white spaces were eliminated by simply putting a meaningless symbol between words. The children read both filled and unfilled material, some silently and some aloud. We measured comprehension and speed of reading. The results were as we expected. Eliminating white spaces created more difficulty for the fifth and sixth graders and bothered the first and second graders very little.

We interpret these findings to mean that the fifth and sixth graders have developed a sampling strategy which depends on the spaces around words to decide where to move ahead in the text. If this major cue is removed, their reading behavior disintegrates. The first and second graders, on the other hand, are reading one word chunks. This primitive sampling strategy is less dependent on physiognomic cues so that removing inter-word spaces does not seriously impair their reading.

Study No. 2: The effects of grammatical structure on reading. We have been using an old technique to study the ways a reader unitizes or "chunks" information from the printed page. The method is the eye-voice span, which was studied so profitably by Buswell at Chicago in

the early 1920s. There is actually a history of the use of this technique going back to the end of the last century.

The technique is reasonably simple. The subject reads carefully prepared aloud material. Then he is prevented from reading further by turning off the light. At this point, the reader is asked to report how much more he can recall having seen. The number of words beyond his voice that he remembers seeing is the eye-voice span. The method can be refined by using an eye-movement camera. The method gives you an indirect picture, though a valid one, of where the reader has scanned ahead.

The evidence is clear that the eye-voice span is neither random nor fixed. The reader does not pick up two or three or four words ahead. Rather, the size of the chunks he picks up beyond where he is reading aloud depends on the grammatical structure of the material that he is reading. The hypothesis we tested was that chunking occurs in phrase units.

In the first of two studies, the subjects were second, fourth, sixth, eighth, tenth grade students and adults, who were given carefully constructed sentences to read. These sentences were made up either of two-word, three-word, or four-word phrases, as well as word lists: that is, a sentence-like string of words that had no relationship to each other.

On these word lists, the eye-voice span tends to be rather short: two words, on the average beyond where the voice is. The span on meaningful material, on the other hand, roughly doubles this. On the average, one reads ahead four words, and in some instances it may (be) as high as six words. The predictability or meaningfulness of the material obviously controls how large a chunk the reader is sampling.

Several other findings. The eye-voice span gets larger and larger the older the child. Also the more rapid the reader, the longer his eye-voice span. The people who read aloud rapidly are the ones who are systematically processing larger chunks of material.

There is a strong tendency in all of our subjects from the second grade on, to read in phrase units. When we turned off the light at the beginning of a phrase and asked, "How much more can you remember?", they would usually report to the end of that phrase. They much less often jumped over the phrase boundary to report material in the subsequent phrase. When subjects were shown words from subsequent phrases and asked if they recognized them, they do report having seen some words which existed toward the end of a succeeding phrase. These observations suggest that the active search in the sampling of sentences tends to be in phrase units and also tends to be first toward the end of the phrase and then back toward the beginning. So far as English is concerned, this is adaptive because the ends of phrases are highly informative.

The tendency to stop at phrase boundaries occurs for all age levels from the second grade on, and is clearer for the rapid readers.

The final study that I will describe compared the eye-voice span reading active (the boy runs home) and passive (The boy is hit by the ball) sentences. The subjects were adults. In this study, the lights were turned off systematically at various places in the sentence. The finding is clear that the EVS is larger in passive sentences compared to active sentences. Once the reader had picked up the by-phrase in the passive sentence, the reading chunk was quite large. In this experiment,

as in the earlier one, readers tended to pick up information in phrase units.

All these findings outside of the first study on spaces, which is really a different domain of research, can be subsumed under one assumption. That is, sampling as indicated by the eye-voice span is controlled by the redundancy or the predictability of the material. For example, if you read the sentence fragment, "the boy is hit...," most people will anticipate a following by-phrase. This is what I mean by high predictability. The findings, then, are that readers tend to take in information in phrase units and that the size of the units are larger in passive than in active sentences. Both results follow from the predictability notion: the form of passive sentences is more predictable than active sentences and sequences of words are more predictable within phrases than between phrases.

What are the implications for teaching? There are many cues that one uses in reading. An obvious set are the spelling-to-sound relationships, the so-called phonic cues. There are also grammatical and meaning cues. If your purpose is to teach the child the complex skill of reading, that is, to process or sample the printed page, what strategies do you adopt? Do you first teach him sub skills? Do you teach him to use the whole interchangeable melange of cues which are used in reading? Do you teach these skills simultaneously? These are researchable questions. Our decision,based on the above research as well as other studies, has been to acquaint the child with mixed strategies early in his learning to read. We are finding this preferable

to focussing on one strategy then another, in sequence.

Let me summarize, I have postulated that mature reading involves sampling the printed page. The sampling is based on various cues and the ones I have emphasized are grammatical. From these findings, I have drawn the inference that children who are learning to read should be familiar with various cues including phonics, grammatical and meaning aspects of the materials, since all of these in complex combination lead to mature reading behavior.